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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 81862.P157 Total Pages 5

First Named Inventor or Application Identifier Pete N. Moore

Express Mail Label No. EL371011509US

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, D. C. 20231

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

1. x Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. x Specification (Total Pages 17)
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. x Drawings(s) (35 USC 113) (Total Sheets 9)

4. x Oath or Declaration (Total Pages 6)
   a. x Newly Executed (Original or Copy)
   b. ___ Copy from a Prior Application (37 CFR 1.63(d))
   (for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**
   i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ____ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ____ Microfiche Computer Program (Appendix)

7. _____ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. ____ Computer Readable Copy
b. ____ Paper Copy (identical to computer copy)
c. ____ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. _x_ Assignment Papers (cover sheet & documents(s))
9. _____ a. 37 CFR 3.73(b) Statement (where there is an assignee)
_x_ b. Power of Attorney
10. _____ English Translation Document (if applicable)
11. _____ a. Information Disclosure Statement (IDS)/PTO-1449
_____ b. Copies of IDS Citations
12. _____ Preliminary Amendment
13. _x_ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. _____ a. Small Entity Statement(s)
_____ b. Statement filed in prior application, Status still proper and desired
15. _____ Certified Copy of Priority Document(s) (if foreign priority is claimed)

16. _x_ Other: Copy of Postcard w/Express Mail Stamp

17. **If a CONTINUING APPLICATION,** check appropriate box and supply the requisite information:
___ Continuation ____ Divisional ____ Continuation-in-part (CIP)
of prior application No: _

18. **Correspondence Address**
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081862.P157 Patent

United States Patent Application

For

FAIR MULTIPLEXING SCHEME FOR MULTIPLE INPUT PORT ROUTER

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FAIR MULTIPLEXING SCHEME FOR MULTIPLE INPUT PORT ROUTER

FIELD OF THE INVENTION

The present invention relates generally to routing resources that may be used in packet switching networks and, in particular, to a scheme for allocating switching resources of such a router among multiple input interfaces thereof.

BACKGROUND

Routers are commonly used at interfaces between local area networks (LANs) and wide area networks (WANs). For example, routers may be used to multiplex between "N" number of LAN interfaces and "M" number of WAN interfaces. Sometimes, the WAN interfaces may be grouped into bundles through the use of a multi-link protocol, such as the multi-link point-to-point protocol (MLPPP). Such MLPPP bundles may be associated with a specific LAN interface by either a static or policy-based routing implementation.

Figure 1 illustrates a situation where a router resource 10 is used as an interface between N LAN ports 12 and M WAN links 14. The WAN links 14 are grouped into various bundles 16 of, for example, 3 4 or 5 WAN links.

Often, the individual LAN ports 12 are leased by separate customers, each with a variable amount of traffic to be switched through router resource 10. For example, in the situation illustrated in Figure 1, there may be eight 10BaseT LAN ports 12, each associated with a separate customer. These eight LAN ports may be associated through router resource 10 with 24 T1 WAN links 14, grouped into various bundles 16 assigned to the LAN ports 12. The bundling of WAN links 14 provides a variable amount of bandwidth to the customers connecting through the LAN ports 12.

Usually the individual customers have lease rates for router resource 10 associated with the number of WAN ports 14 assigned to their respective LAN interfaces. The number of WAN ports so bundled is generally determined by the amount of traffic the customer will have to transmit through router resource 10. However, owing to the nature in which router resource 10 operates, if one customer (or a few customers) over drives its (their) respective LAN interface(s) beyond capacity, router resource 10 can become overloaded and cause significant loss of performance for the other customers. That is, over driving just one of the LAN ports 12 may cause traffic on other LAN ports 12 to be dropped. What is needed, therefore, is a means of preventing traffic on one, or few, LAN ports of router resource from dramatically affecting performance on other LAN ports thereof.

SUMMARY OF THE INVENTION

The present scheme provides a mechanism for preventing traffic from one (or a few) LAN ports of a router resource from dramatically affecting performance on other LAN ports thereof. In one embodiment, the utilization of a router resource at the interface between a first number of local area network ports and a second number of wide area network links by each LAN port is controlled according to the bandwidth availability of corresponding bundles of the WAN links assigned to each of the LAN ports and a switching capacity of the router resource. In this scheme, individual ones of the LANs ports may be permitted to exceed their fair share of the switching capacity of the router resource, but only if a current switching load due to the traffic from all of the LAN ports is less than the maximum switching capacity for the router resource as a whole. If the current switching load due to traffic from all of the LAN ports is equal to the maximum switching capacity of the router resource, however, then those of the LAN ports that are attempting to utilize more than their fair share of the bandwidth availability or the switching capacity may be throttled back. Such throttling back may include dropping packets inbound on those LAN ports that are attempting to utilize more than their fair share of the resources, preferably at the entry point to the router resource. Such a scheme may also operate in the reverse direction, controlling traffic from the WAN links bound for the LAN ports.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not limitation, in the figures of the accompanying drawings in which like reference numerals refer to similar elements and in which:

Figure 1 illustrates a router resource positioned as an interface between a number of LAN interfaces and a number of WAN interfaces;

Figure 2 illustrates the use of bandwidth and switch rate virtual buckets for a router resource in accordance with an embodiment of the present invention;

Figure 3 is a flow diagram illustrating a scheme for determining whether or not packets should be admitted to a router resource in accordance with an embodiment of the present invention; and

Figures 4a–4f illustrate various test results for a router resource under conditions where one or more interfaces are attempting to utilize more than their fair share of bandwidth or switching capacity thereof.

DETAILED DESCRIPTION

As indicated above, described herein is a scheme for controlling utilization of a router resource, which may be positioned at the interface between a number of LAN ports and a variety of WAN links. However, although this scheme will be described with reference to certain preferred embodiments, this description should not be read as limiting the more general applicability of the present invention, as expressed in the claims which follow. For example, the scheme may operate to control traffic bi-directionally. That is, traffic inbound on the WAN links may be controlled in a like manner. Also, the router resource may be any device configured as a router or not. Accordingly, the schemes described herein, and the test results presented therewith, should be regarded as exemplary, and not exclusionary.

The general solution provided by the present scheme can be discussed with reference to Figure 2. As will become apparent, one advantage offered by the present scheme is that traffic on one customer's LAN port (or a few customers' LAN ports) is prevented from dramatically affecting performance on other LAN ports of the router resource. In accordance with the present scheme, software and/or hardware components of a router resource 20 monitor, and when necessary, drop or otherwise control packets inbound on one or more LAN ports 22. This occurs, preferably, at a packet's entry point into the router resource 20. The entry point is chosen because the sooner a packet is dropped, the less impact it will have on the router's overall performance and on other customers' traffic. Further, such an implementation minimizes the overhead involved in processing the dropped packets.

As shown, router resource 20 provides an interface between N number of LAN ports 22 and M number of WAN links 24, where the WAN links may be grouped into bundles 26 (of say 3, 4 or 5 individual WAN links). Associated with each LAN port interface is a

bandwidth bucket 28 and a switch rate bucket 30. Those of ordinary skill in the art will appreciate that the term bucket is used herein in a virtual sense. That is, so-called leaky bucket models are used to represent the storage of packets associated with a given interface in router resource 20. In general, router resource 20 may be any network resource that performs a routing function, for example, an Internet protocol (IP) router. In addition to the bandwidth and switch rate buckets 28 and 30 associated with each LAN port 22, a global switch rate bucket 32 for router resource 20 is maintained.

In accordance with the present scheme, each LAN port 22 is assigned a portion of the overall global switch rate capacity of the router resource 20. In some cases, this may involve an equal (or fair) distribution among each of the LAN ports 22 of the global switch rate capacity. In other cases, capacity may be allocated in other than equal amounts, although in such cases the allocation may still be deemed "fair" according to another factor, for example lease cost. One of the goals of the present scheme is to maintain this fair allocation among LAN ports 22, even as one or more of the ports is over driven with traffic. To do so, two basic dimensions are monitored.

First, available bandwidth based on a LAN port's assigned WAN bundle's bandwidth capacity is monitored. This available bandwidth is derived from the bandwidth capacity of each WAN link 24 within a bundle 26, multiplied by the number of links in that bundle. Second, the router resource switching capacity is monitored. Every router resource 20 will have a maximum switching capacity. If an individual LAN port 22 begins to exceed its allocated share of this switching capacity, the present scheme first checks to see whether the router resource 20 as a whole is being utilized at its maximum capacity. If not, then there is no need to throttle back a port that is exceeding its allocated share and that port is allowed to utilize more than its allocated share of the switch rate. However, if the route resource 20 is

already operating at its maximum switching capacity, then LAN ports exceeding their allocated share thereof will be throttled back. This prevents excess traffic from individual LAN ports from affecting the performance of other ports.

Monitoring both of the above dimensions ensures good flow control through router resource 20. For example, bandwidth can often be exceeded when the packets making up the traffic on an individual LAN port are relatively large. However, switching capacity may be exceeded when small packet traffic is being processed through router resource 20. By monitoring both dimensions true fairness and efficient flow control can be achieved.

The present scheme differs from existing quality of service/guaranteed service implementations in routers, which typically use a post-routing function that involves bandwidth admission and packet scheduling constraints derived from an output port's capacity. The present scheme is designed for an application where the bandwidth of the output port is deterministic, based on the input port. Thus, the present scheme takes advantage of this deterministic value in order to implement fairness with minimum overhead.

Figure 3 provides an example of the overall processing used by the present scheme. For each LAN port 22, as a packet arrives an initial check is made to see whether the buffer associated with that LAN port is getting full. That is, for each inbound LAN port, there will be a memory resource of router resource 20 (referred to as a buffer) that stores packets associated with that LAN port. In some cases, this may be a portion of a shared memory resource for router resource 20. Usually, each buffer has an associated threshold. Thus, the initial check determines whether or not that threshold has been exceeded by the number of packets currently stored for the LAN port.

If the number of packets for the LAN port under consideration is not at or above its associated buffer threshold, then the present scheme may decided not to drain the buckets

associated with that LAN port. This can be a helpful implementation where large packet traffic is expected on a LAN port and the latency of the returning LAN input buffers is high.

In a normal case, however, the buckets associated with the LAN port of interest are drained, as is the global switch rate bucket 22. Individual drain rates for the buckets are determined according to their associated parameters. That is, bandwidth buckets 28 are drained at a rate determined by the available bandwidth on the associated WAN bundle 26. Switch rate buckets are drained at a rate according to their allocation of the overall router resource switch rate. The global switch rate bucket 32 is drained according to that portion of the overall switch rate for router resource 20 assigned to the LAN port of interest.

After the above determination as to whether or not the buckets are to be drained is made, a determination as to whether or not the arriving packet should be dropped is made. First, the bandwidth bucket 28 associated with the LAN port of interest is checked. If the bucket is already full, the new packet is not accepted (i.e., it is dropped). Also, the switch rate bucket 30 for the LAN port of interest is checked to see if that port is exceeding its allocation of the global switch rate for router resource 20. Only if the allocated switch rate is being exceeded is the global switch rate bucket 32 checked. If the global switch rate bucket 32 is full, then no additional allocation can be made to LAN port associated with the incoming packet, and the packet will have to be dropped. In such cases, the switch rate bucket associated with the LAN port of interest is throttled back so that it does not exceed its fair share (i.e., the previous allocation of the global switch rate).

Thus, if the present scheme determines that bandwidth congestion or switch rate excess has been experienced, the arriving packet is dropped. Otherwise, the packet is accepted into the buffer associated with the arriving LAN port and the bandwidth and switch

rate buckets associated therewith, as well as the global switch rate bucket, are incremented to account for the newly arriving packet.

Thus, the present scheme makes a drop or forward decision for each packet as it arrives on an inbound LAN port. Packets are dropped if the LAN port's inbound bandwidth is exceeding the associated WAN bundle's bandwidth; or the LAN port's input packet switch rate is exceeding its allocated share, and the router resource 20 is operating at maximum switch rate capacity. Individual LAN ports will be allowed to switch at rates beyond their allocated share, but only so long as the router resource 20 is not operating at its maximum capacity. Note, similar decisions can be made for traffic flowing in the reverse direction.

Examples of the effects produced by the present scheme are shown in Figures 4a-4f. In Figure 4a, an example of the input and output traffic on 8 LAN ports and their associated WAN links is illustrated with switching rate (expressed as packets per second) plotted against port number. In this example, 64-bit packets were used and LAN port number 1 was over-driven. That is, the number of packets being presented through LAN port number 1 far exceeded that port's fair allocation (in this case, an equal distribution) of the total available switching rate of the router resource. For this example, the fair allocation mechanism of the present invention was not utilized.

As shown, by over-driving LAN port number 1, the effective output of each of the other LAN ports is far reduced from that of the WAN output associated with LAN port number 1. Although each of LAN ports 2-8 is able to produce approximately the same WAN output, it is clear that LAN port number 1 is robbing these other LAN ports of their fair share of the total available switching rate of the router resource. The figure also shows traffic flow in the reverse direction, which is also affected.

This situation becomes even worse where two LAN ports are over-driven, as shown in Figure 4b. Now, the effective output for LAN ports 3-8 is almost 0.

Contrast this with the situation depicted in Figure 4c, where the same two LAN ports are being overdriven, however, the fair allocation scheme of the present invention is introduced. Now, LAN ports 3-8 are provided with their fair share of the overall switch rate of the router resource and are able to switch traffic even in the presence of the greedy LAN ports 1 and 2.

Figure 4d illustrates another case, this time for 1500- bit packets, where each LAN port is being utilized at close to its associated WAN bandwidth capacity. The fair allocation scheme of the present invention ensures that no port is allowed to accept packets in such a way that allows the associated WAN links output bandwidth to be exceeded.

Figure 4e illustrates a situation, again using 1500- bit packets, where one LAN port is being extremely overdriven and the remaining ports do not have the advantage of a fair allocation scheme. Again, WAN output for ports 2-8 are dramatically reduced from that shown in Figure 4d. [is something missing re port 1?]

Compare this with the situation illustrated in Figure 4f, where even in the presence of four LAN ports being extremely over-driven, the present fair allocation scheme ensures that the remaining LAN ports still receive their fair share of overall switching capacity. Thus, LAN ports 5-8 are able to switch traffic at a rate equal to their share of the overall switching rate of the router resource.

Thus, a scheme for controlling the utilization of a router resource has been described. This scheme may be embodied in a variety of ways, for example as a server of computer-readable instructions (commonly referred to as software), which may be instantiated in a variety of ways. For example, the software may be embodied as instructed in object code

(i.e., machine-readable format) or source code (i.e., human-readable format); as embedded in an integrated circuit (e.g., stored in memory or fashioned as one or more application specific integrated circuits); or as stored on a computer-readable medium (e.g., a floppy disk or CD-ROM). In still other cases, the software may take the form of electronic signals transported through a communication medium (e.g., telephone lines, xDSL lines, wireless communication links, etc.), as when the software is being downloaded from a server or other host platform or is being electronically distributed between two or more computers. Thus, the more general applicability of the present scheme should not be limited by the examples that have been presented herein and, instead, should only be measured in terms of the claims which follows.

CLAIMS

What is claimed is:

1. A method, comprising controlling utilization of a router resource at the interface between a first number of local area network (LAN) ports and a second number of wide area networks (WAN) links by each LAN port according to bandwidth availability of corresponding bundles of the WAN links assigned to each of the LAN ports and a switching capacity of the router resource.

2. The method of claim 1 wherein individual ones of the LAN ports are permitted to exceed their fair share of the switching capacity of the router resource if a current switching load due to traffic from all of the LAN ports is less than a maximum switching capacity for the router resource.

3. The method of claim 1 wherein if a current switching load due to traffic from all of the LAN ports is equal to a maximum switching capacity of the router resource then those of the LAN ports that are attempting to utilize more than their fair share of the bandwidth availability or the switching capacity are throttled back.

4. The method of claim 3 wherein throttling back a LAN port comprises dropping packets inbound on that port at the packets' entry point to the router resource.

5. A method, comprising determining, at an entry port of a router resource, whether or not to admit inbound traffic according to a fair allocation distribution scheme that allows traffic to be admitted according to bandwidth availability of a corresponding exit point for the traffic and a current utilization of total switching capacity of the router resource.

6. The method of claim 5 wherein the fair allocation scheme allows, traffic to be admitted so long as the bandwidth availability of the corresponding exit point exists.

7. The method of claim 5 wherein the fair allocation scheme allows traffic to be admitted even if a port of the router resource associated with that traffic is exceeding an allocated amount of the total switching capacity of the router resource so long as the total switching capacity of the router resource has not been attained.

8. The method of claim 7 wherein the fair allocation scheme allows traffic to be admitted so long as the bandwidth availability of the corresponding exit point exists.

9. A routing resource configured to provide fair allocation of switching capacity among a number of input ports thereof according to output bandwidth capacity of output links associated with the input ports and total switching capacity utilization of the routing resource.

10. The routing resource of claim 9 wherein the fair allocation is maintained by throttling back those input ports which attempt to exceed the output bandwidth capacity of their associated output links or which attempt to utilize more than their allocated share operating at the total switching capacity.

11. The routing resource of claim 10 wherein throttling back comprises dropping packets at an ingress point of the routing resource.

12. A router configured to communicatively couple a first number of local area network (LAN) ports with a second number of wide area network (WAN) links according to

bandwidth availability of bundles of the WAN links assigned to each of the LAN ports and a switching capacity of the router.

13. The router of claim 12 wherein the router if further configured to permit individual ones of the LAN ports to exceed their fair share of the switching capacity of a current switching load due to traffic from all of the LAN ports is less than a maximum switching capacity of the router.

14. The router of claim 12 wherein the router is further configured to throttle back those of the LAN ports exceeding their fair share of the switching capacity when a total switching load due to traffic from all of the LAN ports is equal to a maximum switching capacity of the router.

15. The router of claim 14 wherein throttling back a LAN port comprises dropping one or more packets.

16. Computer-readable instructions configured to permit a router resource to determine at an entry point thereof, whether or not to admit inbound traffic according to a fair allocation distribution scheme that allows traffic to be admitted according to bandwidth availability of a corresponding exit point for the traffic and a current utilization of total switching capacity of the router resource.

17. The computer-readable instructions of claim 16 wherein the fair allocation scheme allows traffic to be admitted so long as the bandwidth availability of the corresponding exit point exists.

18. The computer-readable instructions of claim 16 wherein the fair allocation scheme allows traffic to be admitted even if a port of the router resource associated with that traffic is exceeding an allocated amount of the total switching capacity of the router resource so long as the total switching capacity of the router resource has not been attained.

19. The computer-readable instructions of claim 18 wherein the fair allocation scheme allows traffic to be admitted so long as the bandwidth availability of the corresponding exit point exists.

20. The computer-readable instructions of claim 16 wherein the fair allocation is maintained by throttling back those input ports which attempt to exceed the output bandwidth capacity of their associated output links or which attempt to utilize more than their allocated share operating at the total switching capacity.

21. The computer-readable instructions of claim 20 wherein throttling back comprises dropping packets at an ingress point of the routing resource.

22. The computer-readable instructions of claim 16 as embodied on a computer-readable medium.

23. The computer-readable instructions of claim 16 as embodied in electronic signals transported through a communication medium.

ABSTRACT

The present scheme provides a mechanism for preventing traffic on one ore more LAN ports from dramatically affecting performance on other LAN ports of a router resource. In one embodiment, the utilization of a router resource at the interface between a first number of local area network ports and a second number of wide area network links by each LAN port is controlled according to the bandwidth availability of corresponding bundles of the WAN links assigned to each of the LAN ports and a switching capacity of the router resource. In this scheme, individual ones of the LAN ports may be permitted to exceed their fair share of the switching capacity of the router resource, but only if a current switching load due to the traffic from all of the LAN ports is less than the maximum switching capacity for the router resource as a whole. If the current switching load due to traffic from all of the LAN ports is equal to the maximum switching capacity of the router resource, however, those of the LAN ports that are attempting to utilize more than their fair share of the bandwidth availability or the switching capacity may be throttled back. Such throttling back may include dropping packets inbound on those LAN ports that are attempting to utilize more than their fair share of the resources, preferably at the entry point to the router resource.

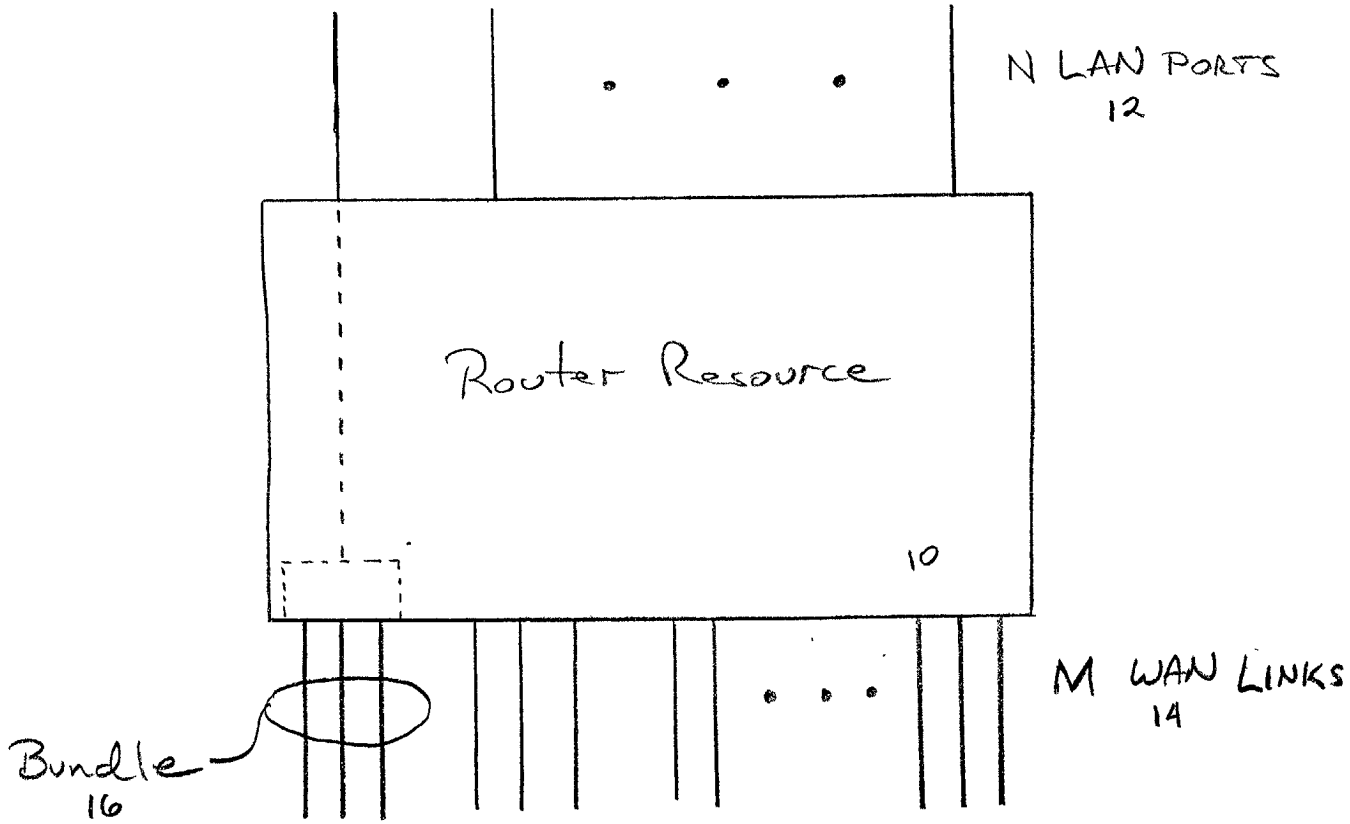

Fig. 1

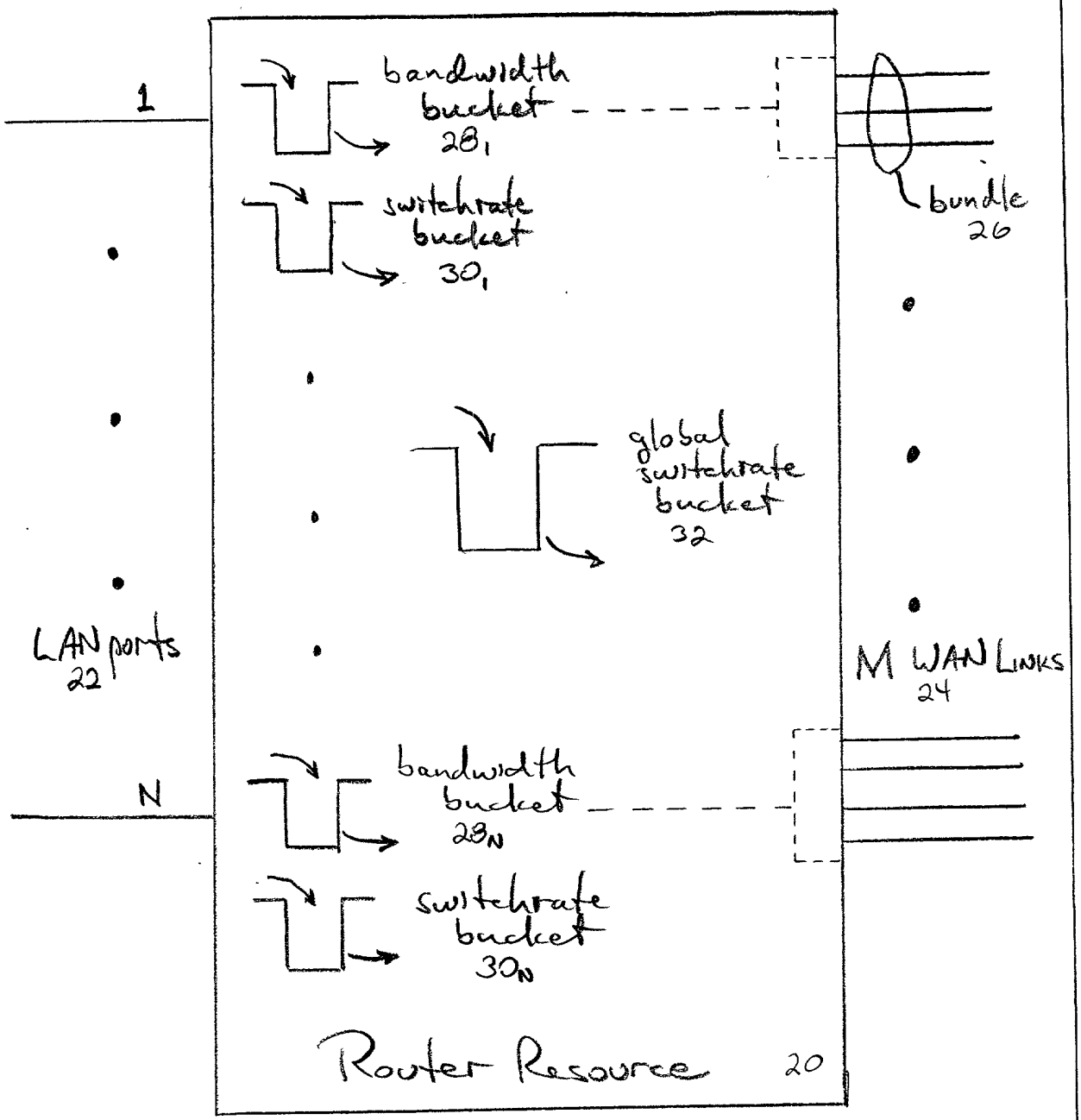

Fig. 2

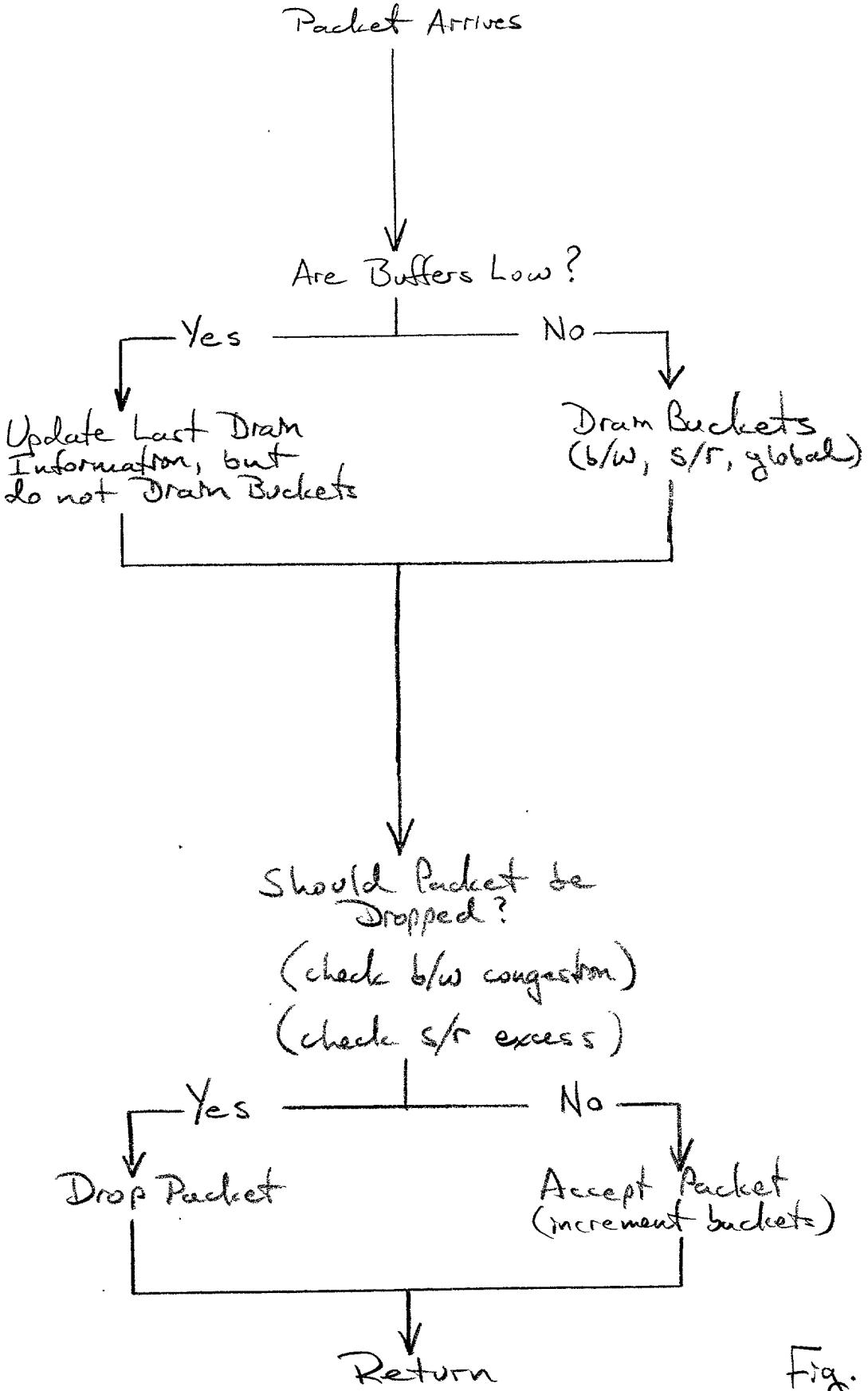

Fig. 3

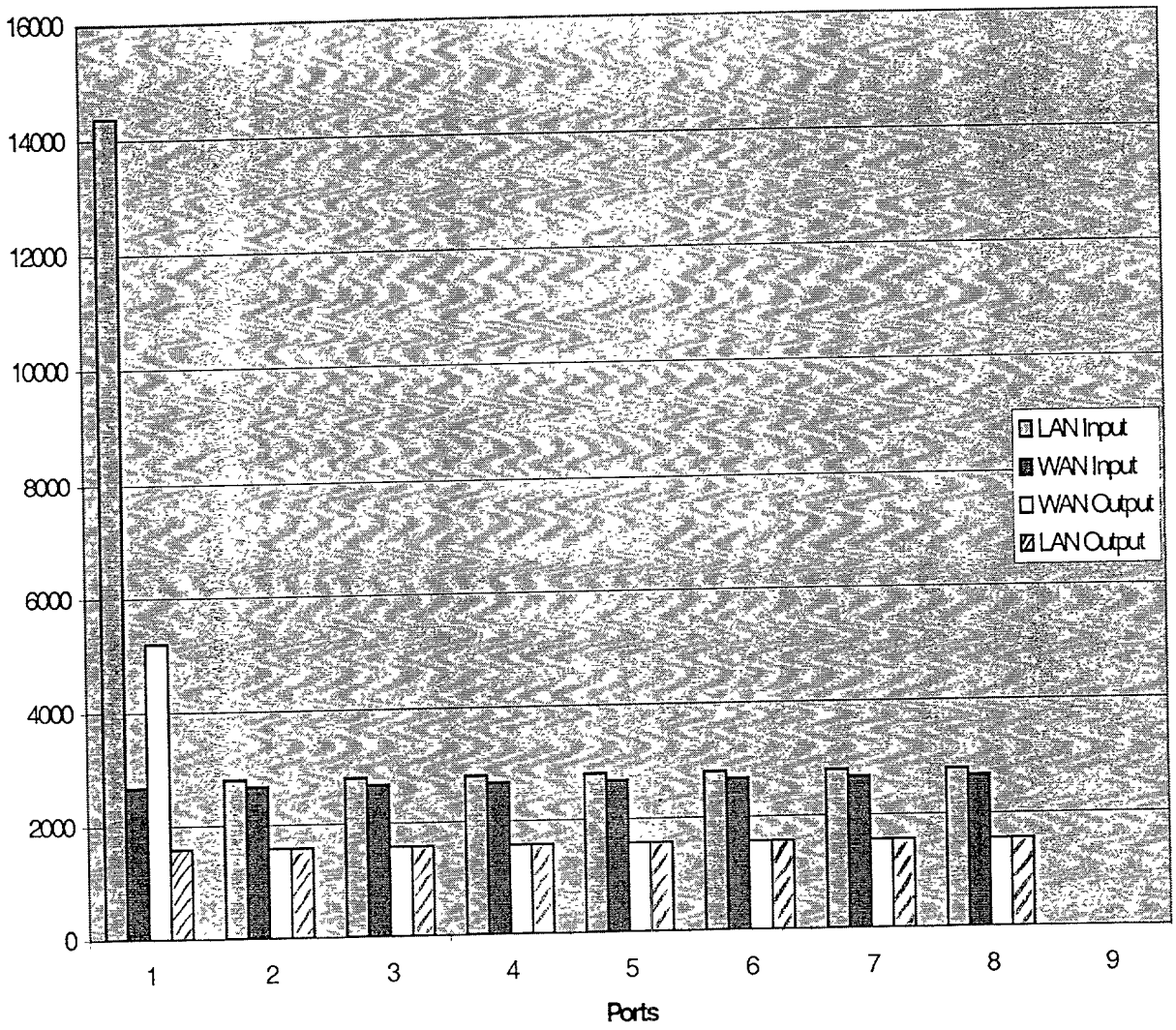
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Fig. 4a

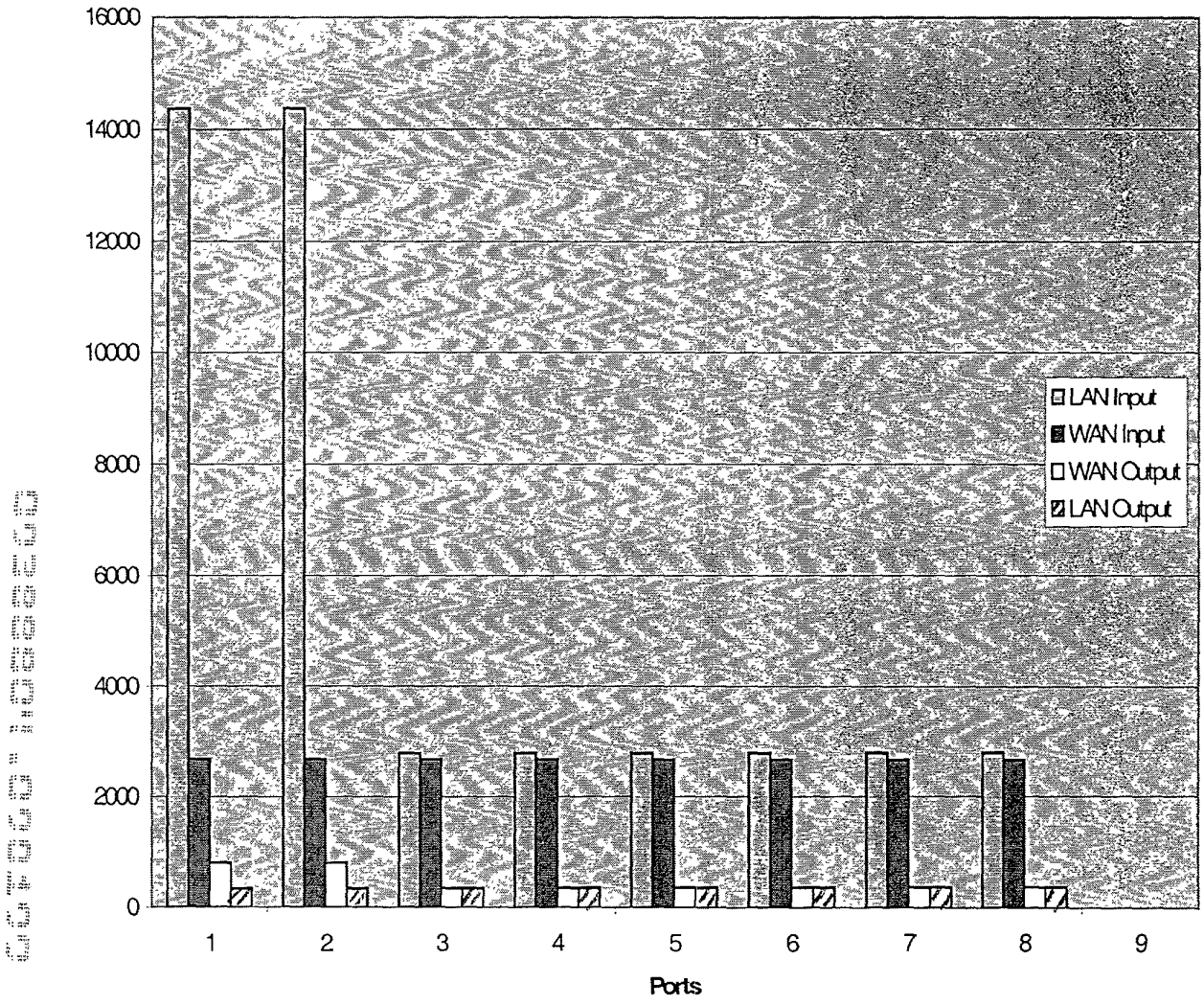
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Fig. 4b

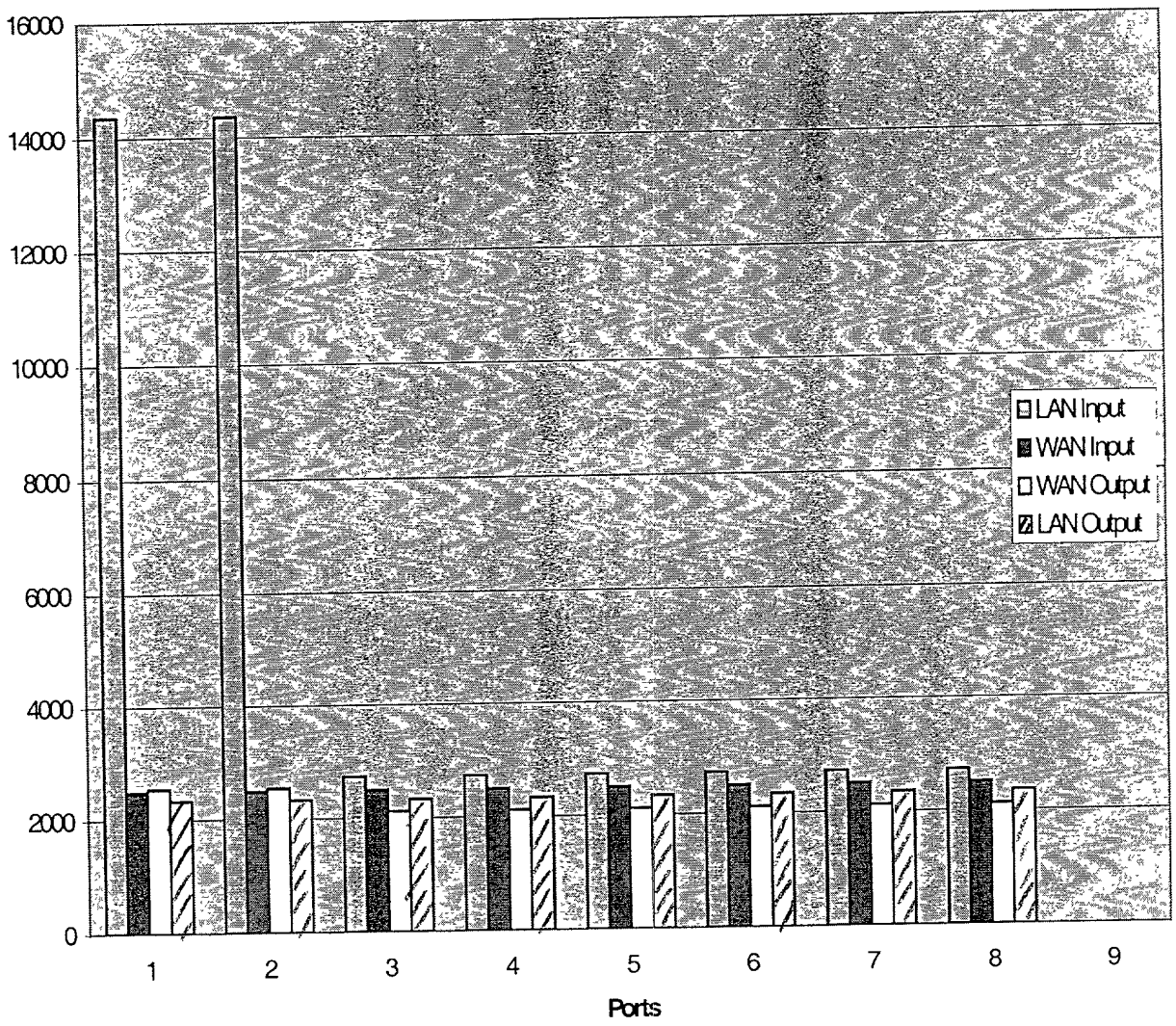
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Fig. 4C

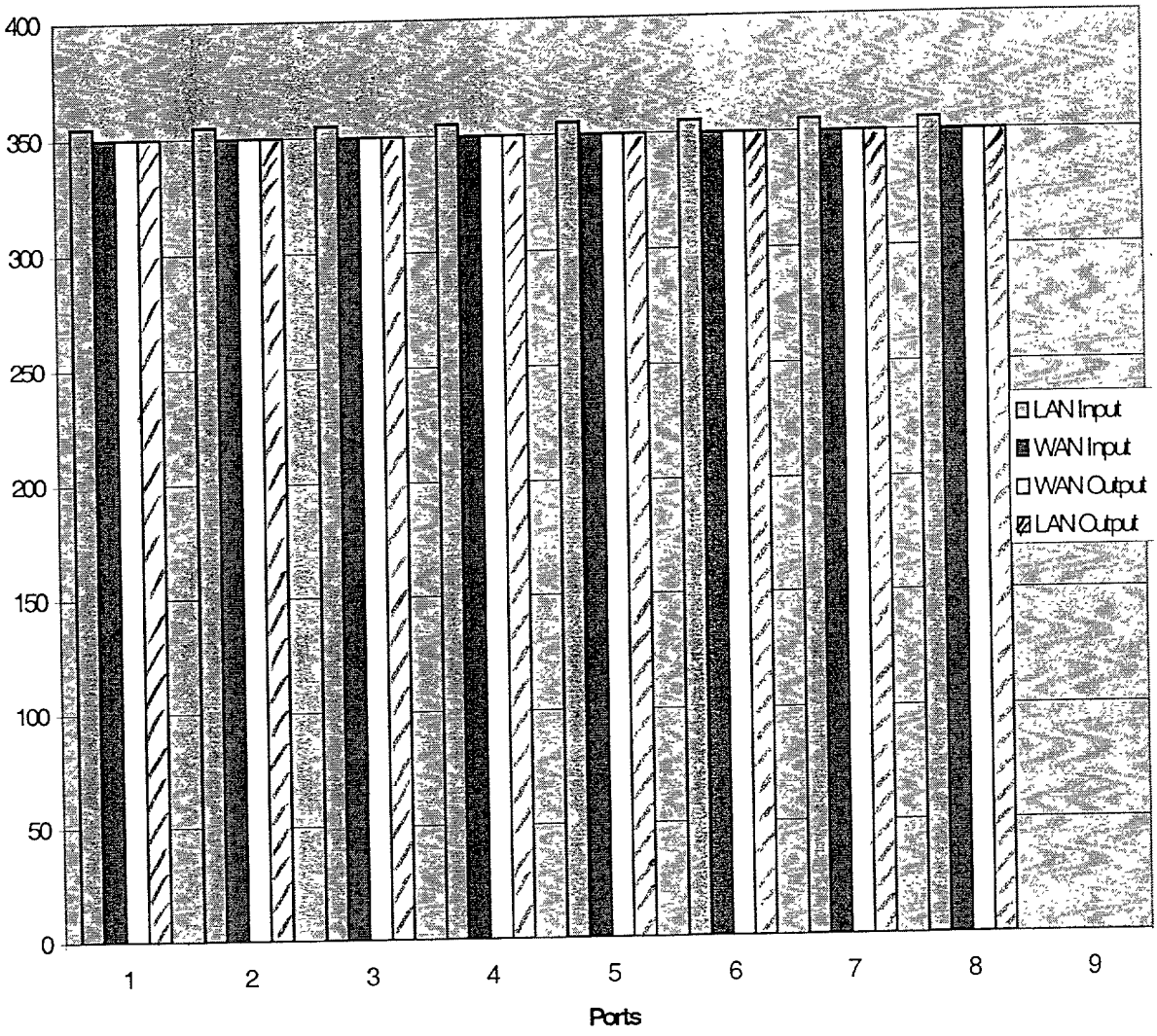
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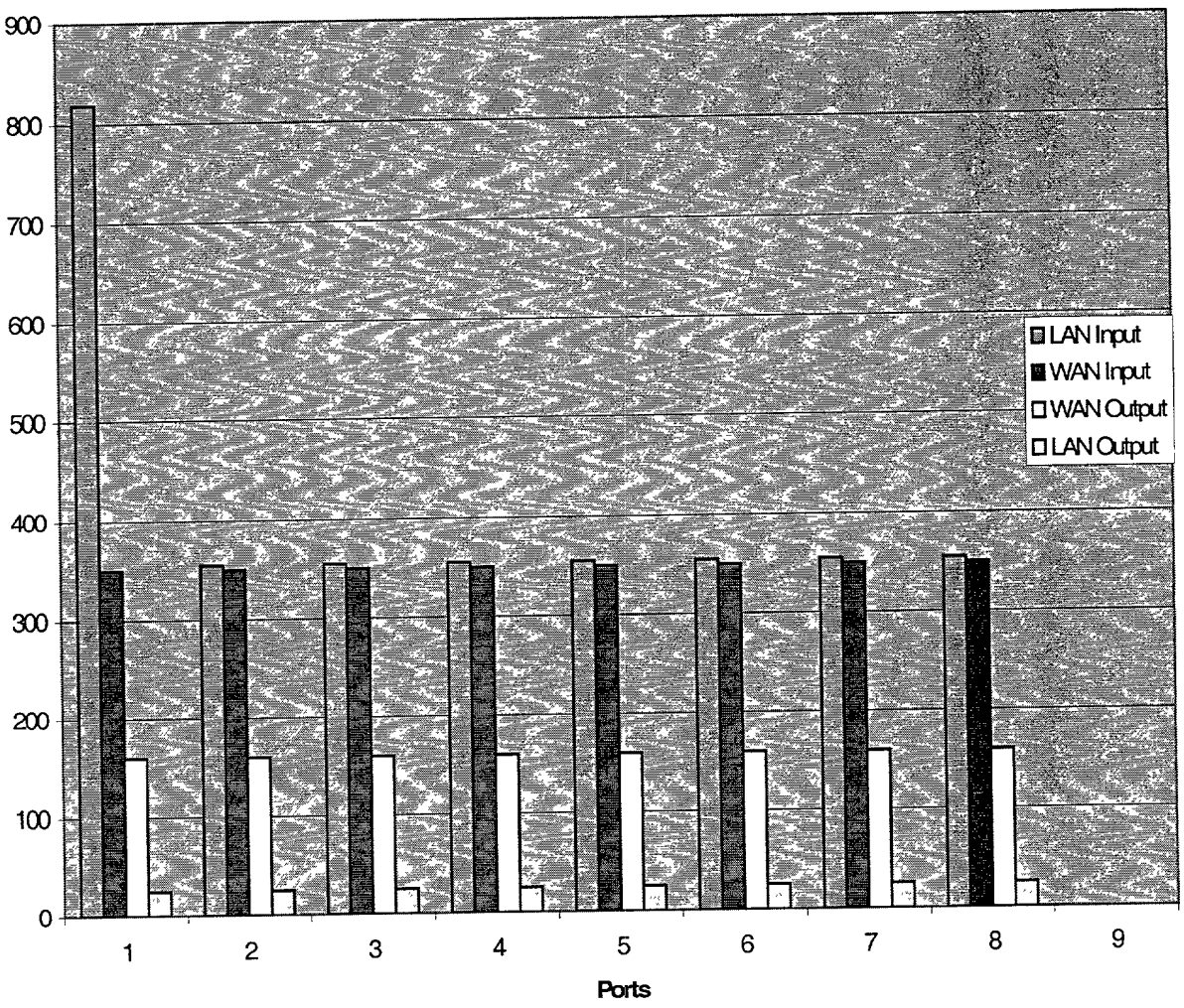
Fig. 4d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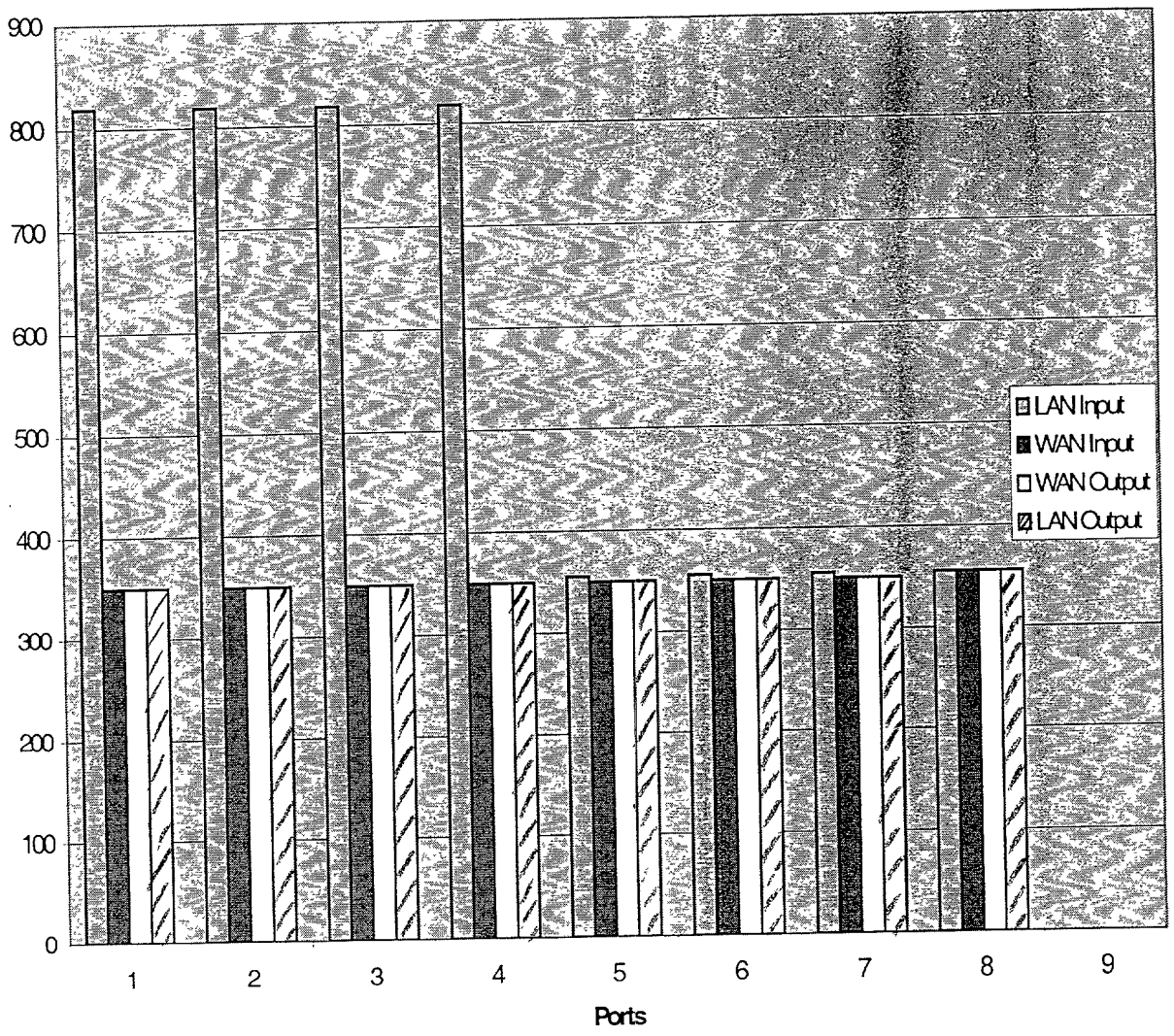
LAN Output

Fig. 4e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Ports
LAN Input
WAN Input
WAN Output
LAN Output

Fig. 4f

Attorney's Docket No.: 081862.P157 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

FAIR MULTIPLEXING SCHEME FOR MULTIPLE INPUT PORT ROUTER

the specification of which

XX is attached hereto.

___ was filed on _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Tarek N. Fahmi, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to Tarek N. Fahmi, (408) 720-8598.

(Name of Attorney or Agent)

(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Pete N. Moore

Inventor's Signature Pete N Moore Date 8/31/99

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Inventor's Signature _____ Date _____

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Full Name of Third/Joint Inventor _____

Inventor's Signature _____ Date _____

Residence _____ (City, State) Citizenship _____ (Country)

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Full Name of Fourth/Joint Inventor _____

Inventor's Signature _____ Date _____

Residence _____ (City, State) Citizenship _____ (Country)

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by

disclosing information to the attorney, agent, or inventor.

United States Patent & Trademark Office

Office of Initial Patent Examination -- Scanning Division

Application deficiencies were found during scanning:

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(Document title)

☐ Page(s)_____ of _____ were not present for scanning.
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☐ Scanned copy is best available.